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Case Report

Two death cases originating from supplementary heater in the cabins of parked trucks ☆

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ABSTRACT

A supplementary heater can be mounted in trucks or other transportation vehicles and used to heat the air in the cabin independent of the engine of the vehicle. This apparatus works with diesel fuel or gasoline. Combustion products burning in the pre-combustion chamber heat the fins of the engine. The air passing through the fins is heated and is transferred into the cabin. The malfunction of such an apparatus may be the cause of carbon monoxide (CO) poisoning or fire. In this study, we report two cases in which drivers died while asleep in the cabins of parked trucks. In the first case, a 43-year-old man died because of CO poisoning originating from a broken supplementary heater. In the second case, a 48-year-old man died owing to a fire that resulted from the burning of upholstery cloths in the truck cabin, and which was caused by a supplementary heater set at very high temperatures. In both cases, it was determined by a technical expert that the CO poisoning in the first case and the fire in the second case were caused by the supplementary heater in the trucks. It is emphasized in this article that the supplementary heater in the truck might be the cause of mortal CO poisoning as well as be responsible for fires in the cabins of the trucks. It aims to highlight that a detailed investigation of supplementary heaters at the death scene is required for such death cases in the trucks.

1. Introduction

Carbon monoxide (CO) is a colorless and odorless gas, and is lighter than air. It is an incomplete combustion product of hydrocarbons. About 600 accidental deaths due to CO poisoning are reported every year in the United States. CO usually causes accidental deaths, because it is pure and odorless. However, if there are other gases in the medium, the odor of these gases can be detected.[1–4]

Vehicle emissions in industrial countries account for about 50–60% of total emissions; the other categories of CO emissions are other fuel combustion sources, such as steam boilers, industrial processes and solid waste disposal. Exposure to additional CO can be detrimental to human health, and exposure to higher concentrations can result in death. The health effects of CO are largely the result of the formation of carboxyhaemoglobin (COHb), but, in addition to its reaction with haemoglobin, CO combines with myoglobin, cytochromes and metalloenzymes such as cytochrome *c* oxidase and cytochrome P-450.[5]

A car with a catalytic converter that emits less than 0.5% CO during the mandatory inspections can emit substantially more CO under special circumstances. When the car is running in a small garage, the oxygen level in the intake air will decrease owing to the exhaust-gas mixing with the surrounding air. During normal variations in the oxygen level, the Electronic Control Unit of the car ensures that complete combustion occurs, as this is a prerequisite for the function of the catalytic converter. At a certain critical point, the oxygen level will be so low that the Electronic Control Unit can no longer maintain complete combustion, thus disabling the catalytic converter. As a result, a considerable amount of CO will be emitted.[6,7]

CO can also affect drivers of a moving vehicle, usually owing to a defective exhaust system that allows gas to percolate through the floor or engine bulkhead into the interior. Rarely, a strong following wind can blow the external exhaust-gas through the open doors of a van or truck. Another cause is a leak in the heat exchanger in vehicles that use a direct air supply from around the exhaust manifold to provide passenger heating.[4]

In this study, two different cases of drivers who died while sleeping in the cabins of the parked trucks are presented.

2. Case reports

Case 1: The 43-year old male truck driver was found dead in the cabin of a parked truck in an open area (Fig. 1). A dense smell of

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Fig. 1. Case 1 was found dead in the cabin.

Fig. 2. Supplementary heater of the truck (case 1).

Fig. 3. Supplementary heater was adjusted to 2.5/4 (case 1).

diesel fuel was detected in the cabin. The supplementary heater has been adjusted to 2.5°/4° for the purpose of giving hot air flowing into the cabin (Figs. 2 and 3). However, cold air was given into the cabin because the supplementary heater was broken. The body of the driver was facedown on the bunk bed. According to witness statements, the driver was waiting for loading in the truck garage and he had attempted to repair the broken supplementary heater the day before.

Fig. 4. Case 2 was found dead and burned.

Cherry-red lividity, congestion and cyanosis of the face were reported after external examination.

The internal examination showed the organs were bright pink in color, and hyperemia and congestion, and petechial hemorrhages on the lungs were detected. Bright pink liquid owing to lung oedema in the trachea and main bronchial lumen was observed. 62.8% COHb was reported by toxicological analysis of blood.

Case 2: A 48-year old male truck driver was found dead due to a fire in a truck parked in an open area of the truck garage (Fig. 4). The fire was started by burning of upholstery cloths and burnable parts of the truck and was caused by operating a supplementary heater at very high temperatures. It was also determined that the supplementary heater in the truck had been installed subsequently under the driver's seat (Figs. 5 and 6). The driver's seat and the one next to it were folded up towards the front of the truck and the body was found lying on the left side on the lower bunk bed, at the back of the cabin.

The external examination showed that the clothes on the corpse were partly burned, and the lividity was cherry-red in color on unburned parts of the skin. There were second- and third-degree burns, which were getting worse to carbonization on some areas of the right side of the corpse.

Internal examination showed hyperemia and light-red color in all internal organs; oedema in the cerebrum; soot and carbon particles were in the mouth cavity, trachea and the main bronchus;

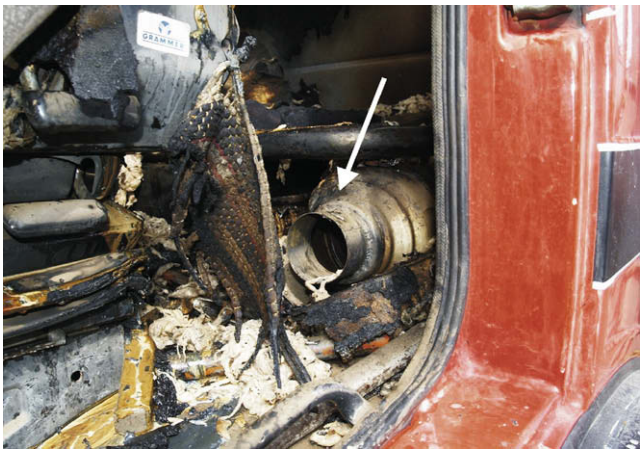

Fig. 5. Subsequently installed supplementary heater (case 2).

Fig. 6. Switch of the supplementary heater (case 2).

and hyperemia in the upper part of esophagus. 70.2% COHb was reported by toxicological analysis of blood.

In both cases, a technical expert determined that CO poisoning in the first case and the fire in the second case were caused by the supplementary heater in the truck.

3. Discussion

CO poisoning is a common pathology with high morbidity and mortality.[8] The most sensitive organs to CO poisoning are the nervous system, which has high metabolic requirements, and cardiac system. Therefore, cardiac, neurological and psychiatric symptoms are common with CO poisoning.[9] COHb levels less than 10% are usually not associated with symptoms. At COHb saturations of 10–30%, neurological symptoms of CO poisoning can occur, such as headache, dizziness, weakness, nausea, confusion, disorientation and visual disturbances.[10] Dyspnea, increases in pulse and respiratory rates, and syncope are observed with continuous exposure, producing COHb levels of 30–50%. At COHb levels greater than 50%, coma, convulsions and cardiopulmonary arrest can occur.[11]

In Turkey, approximately 3% of medico-legal deaths are due to CO poisoning. There are few suicide cases due to CO poisoning, and murders by CO poisoning are very rare.[12,13] The most-common CO suicide method involves sitting in a vehicle while the engine is running in a closed garage or passing the exhaust-gas into the vehicle by a hose. Although deaths from CO poisoning in the vehicle are generally suicidal, the two deaths reported here were accidental.

The passenger space of a vehicle can be heated to a pleasant temperature at low outside temperatures. Usually, it is coupled to cooling of the engine of the motor vehicle. With water-cooled engines, warm water containing a second heat-transfer agent is used to warm the air in the cab. Usually, one can change from circulating air to outside air. With circulating air, the heating is more rapid, as previously warmed air is re-circulated. With outside air, fresh air is supplied into the cab. In both variants, air circulation is supported by a blower with several stages.[14]

In motor vehicles in which persons must remain for a long period of time while the vehicle is parked, for example, trucks with

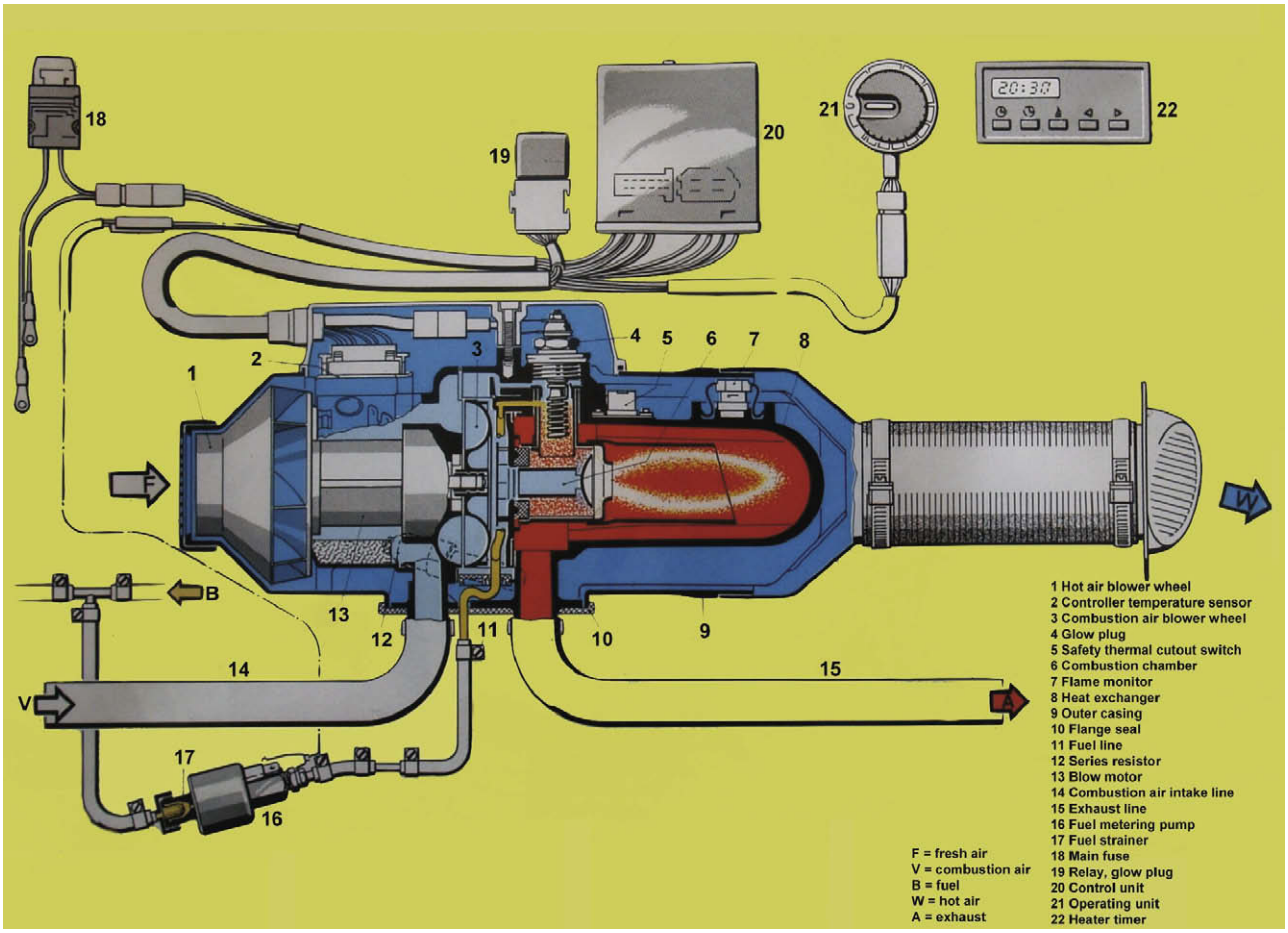

Fig. 7. Schematic of a supplementary heater.

sleeping cabs, road service vehicles and mail trucks, a separate heater (working independently of the engine of the vehicle) may be used to heat the vehicle (Fig. 7). This heater is operated either electrically or with a burner using fuel. The heat is transferred either over a blower directly into the vehicle interior or by means of an electrically operated pump to the cooling water. The independent vehicle heater can often also be time-operated or operated using a remote control, so that a pleasant temperature can be maintained.[15]

The engine of the apparatus works with diesel fuel or gasoline. Combustion products burning in the pre-combustion chamber heat the fins of the engine. The air passing through the fins is heated and is transferred into the cabin. Malfunction of such an apparatus may be the cause of CO poisoning or fire. It is recommended to perform regular, annual maintenance of these types of equipment, as technical defects can cause CO poisoning.

Vacchiano and Torino[16] reported a case in which two people were intoxicated with CO in the same running vehicle, but at different times, owing to a defective vehicle heating system. Osawa et al.[17] reported an autopsy case in which death was caused by accidental CO poisoning in a stationary vehicle idling in an open space. They found that exhaust gases invaded the interior through the floor from a defective exhaust system. The cases reported here are different from those previously reported as death originated from a supplementary heater working independently of the engine of the vehicle and occurred in a parked vehicle. In the first case, the victim died due to CO poisoning, and a dense diesel fuel odor was detected at the scene. CO poisoning was due to a defective supplementary heater. In the opinion of a technical expert, it was determined that the defect was due to a broken gasket that was damaged because of high temperatures, resulting in CO and other gases entering the cabin. On the other hand, the second death was caused by a fire that originated from burning of fabric and flammable parts of the truck cabin. A technical expert investigated the death scene and determined that the fire was caused by operating a supplementary heater at very high temperatures. There are no reports of similar cases in the literature.

These cases are certainly not the first deaths due to CO poisoning or fires caused by a supplementary heater, and other deaths might have occurred in the same way. However, the real cause of CO poisoning or fire could not be determined, because of lacking an examination of the supplementary heater by a technical expert.

In this study, we emphasize that the supplementary heater in the truck might be the cause of fatal CO poisoning and of the fires in the cabins of the trucks. We aimed to highlight that a detailed investigation of supplementary heaters in the death scene by a technical expert is required for accurate determination of the origin of CO poisoning and the fire.

Conflict of Interest

None declared.

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Ethics approval

None declared.

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